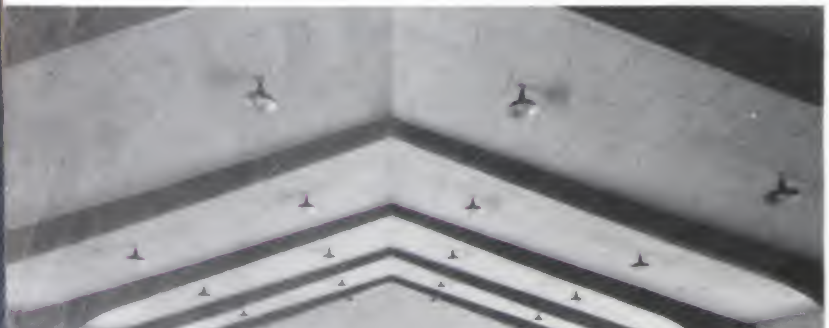
SCHOOL BUILDINGS

Your Tax Dollars Can Afford

ONE STORY SCHOOLS OF
WOOD FRAME CONSTRUCTION

Elementary School, Fairfax, California, John Lyon Reid, Architect, A. I. A. This school design was given an Award of Merit by the American Institute of Architects in 1949 for excellence of design. Photo by Roger Sturtevant.



1. Mt. Vernon School, Bakersfield, Calif. Wright, Metcalf & Parsons, Architects.
2. Sweet Grass County High School Gym, Big Timber, Montana. Monocord timber trusses 78′ span, fabricated by Weyerhaeuser Sales Co., Tacoma, Washington, use Teco shear plate connectors.
3. Charles Evans Hughes Junior High School, Long Beach, Calif. Harold C. Wildman, Architect.
4. Union School, Macon, Ga. N. J. Pascullis, Architect. Six classrooms built in 1949. Schools of this type in Georgia cost between $4.50 and $6.50 per square foot. Teco cantilever trussed rafters used.
5. Greenwood Gym, La Grande, Oregon, Charles B. Miller, Architect. Glued laminated wood arches 64′ span manufactured by Timber Structures Inc., Portland, Oregon.
6. Linda Vista School, Montebello, California.
7. Slauson Elementary School at Azusa, California. Built in 1947. Cost $10.11 per square foot, which is about the average cost at the present time for this type of construction. It was below average costs current at the time it was built.

ONE STORY SCHOOLS OF WOOD FRAME CONSTRUCTION
SAFETY WITH ECONOMY

Foreword

There exist throughout our country school buildings which have cost the taxpayers as much as $2,000.00 and as little as $200.00 per pupil accommodated.

Our elementary and high school students now number around 25,000,000. By 1960 it is estimated this number will be 34,000,000. Facing America in the next decade or so is the need to spend 10 billion dollars or more for new schools.

In the broadest sense the quality of education obtainable in our school buildings is related only remotely, if at all, to the cost of the buildings. But the cost of the buildings *must* be related to the ability of the taxpayer to pay for them.

The first necessity in planning a school building is to accommodate the expected school population, the second is to stay within a budget which will not impose an unbearable burden on the taxpayer.

On the average, about 80% of the cost of a school "plant" goes into foundations and superstructure of the buildings, as distinguished from grounds, lighting and heating, landscaping and other facilities.

Building costs consequently require a large portion of the tax dollar, and therefore, methods of holding down building costs are of major concern. Two important means of minimizing building costs are: (1) use of the most modern methods of design and construction, (2) use of the most economical materials of construction.

The period following World War I will likely be marked in the field of architecture as the age of monumental schools and tall apartment buildings. Similarly the postwar period we are now in may well be designated as the down-to-earth period of one story schools and suburban single family dwellings.

Architects, school boards and taxpayers throughout the country are tending rapidly toward the one story school because:

1. Direct exits from each classroom provide for maximum safety.
2. With smaller schools, the smaller ground sites are easier to obtain.
3. Better class and community facilities are provided.
4. Mobile type of structures may be provided with ease of addition and subtraction as needs grow and decline.
5. Sound, versatile wood frame construction provides economical costs.

Because California has long been noted for its admirable progress in school construction, this bulletin describes and illustrates what has been done there in the use of wood, and it illustrates, too, the one story school trend in other states.

The Timber Engineering Company, an affiliate of the National Lumber Manufacturers Association, presents this bulletin as an aid to the building of schools everywhere.

Prepared and Distributed by the TIMBER ENGINEERING COMPANY, WASHINGTON, D. C.

THE CALIFORNIA WAY

The history of school building development in California, while not exactly typical of other parts of this country, will serve to illustrate trends and developments in wood frame construction which have produced efficient and attractive schools and at the same time led to worthwhile savings.

Compared with much of the United States, California is still a sparsely settled area and thus has been able to avoid many of the necessities of high cost land and congested population. As a consequence, one and two story school buildings predominate and among these *the wood frame building is in the majority.*

Wood frame school buildings usually have been practical but they have not always been as attractive as they are today. Nor have they always been as economical as they can be today, even though no other type of construction has proven to be as economical.

"Keeping up with the Joneses" and a natural desire to express pride in one's community school has perhaps added somewhat to the cost, over and above the minimum essentials which a school must have. The resultant pleasure the taxpayer gets out of admiring comments from visitors to his community often seems to justify the additional expense. But with costs rising, many communities are leading the way to a more practical and realistic approach through the safe and modern one story school.

In the early days of California a school consisted of one or perhaps two buildings with a playground pretty much as provided by Nature. The limited budgets of those days probably provided more pupil capacity per dollar than we get today.

As time went on, more or less formal playgrounds, assembly halls, a swimming pool, a gymnasium and many other desirable features were added, sometimes at the expense of what might be called the backbone of the school, i.e., the classroom. To obtain these additional features within a limited budget meant a concentrated effort on the part of the designer to reduce the cost of the building itself. Many technical advances resulted from this urge, which still exists, but there were also some unfortunate results.

The most dramatic evidence of this was brought to light as a result of the so-called Long Beach earthquake in 1933. Fortunately for the children of that day the earthquake occurred several hours after school had been dismissed, otherwise the

Diagonal wood sheathing provides ample resistance to both earthquake shocks and high winds. This is but one of many solutions to the problem of obtaining structural sufficiency at minimum cost. Mark Twain School, Long Beach, California.

loss of life among school children would probably have been as great or greater than the 120 lives which actually were lost in and about other buildings.

Damage to school buildings during this disturbance, which was not confined to the Long Beach area, was so severe that it led to the passage in 1933, of an Act by the California State Legislature, called the Field Law, requiring that all school buildings should be examined by the State Division of Architecture for structural safety upon request of a School Board or 10 parents. This Act also requires that future schools shall be so designed and constructed as to provide, insofar as possible, adequate safety to the occupants against all expected forces of Nature, including earthquakes of moderate intensity.

As a result of this act and the aggressive enforcement thereof, supported by public endorsement, it may be said that the structural safety of California schools is second to none and that an earthquake of any to-be-expected intensity would probably result in no loss of life, although some property damage might occur.

Although there were relatively few wood frame school buildings in the congested area affected by the Long Beach earthquake, and even though these buildings suffered no damage which could

have caused loss of life if they had been occupied, the resultant inquiry into the structural sufficiency of all types of school buildings has brought about many improvements in all types of construction. Some of these, as related to wood frame construction, will be detailed in the following pages.

Because of the economy of wood construction architects have constantly sought for, and many have found, ways to make it more pleasing to the eye and adaptable to modern demands as illustrated in this booklet.

At the same time, the structural engineer under the ever-observing eye of the State Division of Architecture has had to provide the required structural safety within the limitations set by the architectural plans, which are predicated primarily on appearance and efficient school use.

This has not always been easy to do, but the results which have been obtained, and can be obtained, are noteworthy and may be duplicated in any locality.

Too much attention to ornamentation and not enough to structural safety. A California school after the 1933 earthquake. Photo by I.N.P.

For the past 15 years, and with the added impetus of the change in population brought about by World War II, California has been confronted with both a physical and financial quandary in trying to provide enough school plant to keep pace with its ever-growing number of school children.

Some 2,250 School Districts in the State are directly responsible for solving the many problems involved. It is not surprising that State aid, both in planning and financing has been required in the sparsely populated and economically less favored Districts, many of which have reached their bonded capacity and legal tax rate without adequately providing for school facilities.

The story of the State Aid Law and the various methods of financing school construction are not pertinent to this discussion, but some idea of the magnitude of the problem may be gained from the following figures, taken from the records of the California Division of Architecture.

TABLE I—California Applications Submitted for Approval of Plans and Specifications for Public School Buildings April 10, 1933 to June 30, 1949.

	Buildings	
Los Angeles City Schools	1014	$ 60,604,367.51
Southern California (exclusive of L. A.)	3289	176,225,184.83
San Francisco and Vicinity	847	51,813,300.62
Northern California (exclusive of S. F.)	2030	105,808,375.05
Total	7180	$394,451,228.01

In 1948 a statement made by Governor Earl Warren showed "more than one-third of current state expenditure now is turned to educational use."

A 1949 State bond issue for $250,000,000 to help local school boards was approved. For the next 10 years California will likely spend $50,000,000 yearly.

Glued, laminated wood arches provide the backbone for a multi-purpose building for the Claremont, California, School District. An ultra-modern development, affording maximum safety as well as opportunity for pleasing architectural treatment. Marsh, Smith & Powell, Architects. Hillman & Nowell, Engineers. Stover Bros. Inc., Contractor. 48' V type, glued, laminated wood arches manufactured by Summerbell Roof Structures, Los Angeles, Calif.

WHAT ABOUT THE COST?

How much should a new school cost?

As pointed out in an article in the *Engineering News Record* for September 8, 1949, "the extent of the facilities (auditorium, gymnasium, cafeteria, etc.) to be provided is the controlling factor in the wide variance of costs of constructing schools in the United States."

However, some comparative figures covering all types of materials are available from the above-mentioned source, which records costs of 45 schools located in 18 states and the District of Columbia. Table II shows some of the results of this survey. These figures are very general and should be used with caution.

There were but two strictly wood frame elementary schools listed aside from portable classrooms. The average cost of the two wood frame schools was $347.00 per student or about $9.40 per square foot. These figures compare with a general average for all of the elementary schools of $860 per student or $12.56 per square foot. These figures are not of course conclusive as to relative costs for school buildings of various types of construction.

Carefully compiled figures from a brochure "Sampling School Planning in California," produced in 1948 by the California Council of Architects' Advisory Committee on School House Planning are given below.

TABLE II—Comparative Costs All Types of Materials

	Cost per Student	Cost per Sq. Ft.	Cost per Cu. Ft.
Elementary Schools			
High	$1995	$21.79	
Low	193	5.49	
Average	860	12.56	0.79
Junior High Schools			
High	$2044	$18.50	
Low	565	9.12	
Average	1289	12.10	0.73
High Schools			
High	$1801	$13.11	
Low	249	4.16	
Average	1141	9.84	0.72

With the exception noted, no data is given in the brochure as to date of completion of the buildings. It is believed that most of them are relatively modern, having been built during or since World War II.

Table III accurately reflects the fact that by far the majority of present-day school construc-

Typical of the modern type of elementary school now being erected in many sections of California is this 8-classroom, frame and stucco building at Puente. Designed by Kistner, Curtis & Wright.

tion in California is of the wood frame type. It does not adequately indicate the relative cost of various other types of construction.

Some figures are available, however, indicating relative costs of different types of construction, for various occupancies in all parts of the country. The figures in Table IV, page 6, are taken from the August 1949 issue of "Building Standards," a publication of the American Society of Building Officials. The "Groups" (A, B, C, etc.) refer to the occupancy for which the buildings are intended, and are classified according to the 1949 Edition of the Uniform Building Code of the Pacific Coast Building Officials Conference.

Current costs of wood frame school buildings in California are probably averaging about $9.00 per square foot. Under a State Aid Law the Departments of Education and Finance adopted a formula which set up a figure of $12.00 per square foot for classroom construction. This was subsequently reduced by 15% so that the criterion by which this Department may judge the appropriateness of a given set of classroom plans would now be at about $10.00 per square foot.

Such a figure is of course not inflexible and will vary with many factors, but it does provide a sort of a yardstick by which a given project may be measured.

Although Table IV contains no direct classification showing school costs as distinguished from other buildings intended for public occupancy, the figures do show what is common knowledge in nearly all parts of the country—*that wood frame construction involves the smallest outlay of taxpayer's dollar per square foot of area.*

This much-to-be-desired end is not the only factor to be considered, however, in planning a school "plant." Furthermore, wood frame construction can be wasteful or otherwise, depending on the designer's knowledge and use of modern methods of timber construction.

Some of the considerations which must go into the intelligent design of a school plant, in which it is desired to take advantage of the economies possible with wood frame construction, are discussed below.

TABLE III—Typical California School Building Costs

Name & Classification	Building Area Sq. Ft.	Cost	Cost per Sq. Ft.	Type of Construction
Fairfax Elementary	6,365	$ 68,357	$10.74	**Wood Frame**
Happy Valley Elementary	10,140	110,000	10.84	**Wood Frame**
Acalanes High	67,767	330,000	4.85	**Wood Frame**
Ambrose Elementary	9,900	86,000	8.70	**Wood Frame**
Live Oak Junior High	11,680	144,200	12.35	Concrete, Wood Frame & Brick
Willow Ave. Elementary	16,200	168,709	10.40	**Wood Frame**
Shore View Elementary	10,560	121,247	11.45	Wood Frame & Steel Columns
Escuela Elementary	19,600	227,500	11.60	**Wood Frame**
Palo Alto High (Shops)	16,840	55,424	3.29	**Wood Frame**
Oakdale Grammar	56,600	248,500	4.39*	Reinforced Concrete
Oakdale "Academic" Bldg.	23,000	254,000	11.04	**Wood Frame**
Paso Robles Primary	17,200	100,452	5.84	**Wood Frame**
Roosevelt Elementary	22,600	226,000	10.00	Concrete Block
Atascadero Elementary	8,046	90,964	11.00	Steel Frame & Concrete
Alvin Street Elementary	21,470	255,480	12.00	Steel Bents & Wood Frame
D. S. J. Jr. High	54,116	651,702	12.04	**Wood Frame**
La Canada Elementary	12,097	167,442	13.84	Concrete & Wood Frame
K. L. Carver Elementary	26,000	370,000	13.60	**Wood Frame**
Bella Vista Elementary	13,136	157,877	12.02	**Wood Frame**
L. H. Hoover Elementary	3,800	43,232	11.40	**Wood Frame**
Loma Vista Elementary	9,071	102,000	11.25	**Wood Frame**

* This school completed in 1939. Estimated cost 1948 was $12.00 per sq. ft.

K. L. Carver Elementary School, San Marino, Calif. At a cost of $13.60 per square foot this outstanding wood frame school "has everything." Marsh, Smith and Powell, Architects.

TABLE IV—Building Valuations*

Occupancy Group	Type of Construction	Cost per Sq. Ft. July 1949
Groups A, B & C—Public Assembly including schools	Type I—Concrete or Steel Type II—**Wood and Masonry**	$13.90 **8.20**
Group D—Hospitals, Jails, etc.	Type I—Concrete or Steel Type V—**Wood Frame**	15.30 **6.45**
Groups E, F & G—Retail stores, public garages, warehouses, industrial buildings, office buildings.	Type I—Concrete & Steel Type III—Wood & Masonry Type IV—Steel frame—unplastered Type IV—Steel frame—plastered Type V—**Wood Frame**	6.40 4.50 3.95 4.30 **3.25**
Group H—Hotels & Apartment Houses	Type I—Concrete or Steel Type III—Wood & Masonry Type V—**Wood Frame**	11.75 7.60 **5.45**
Group I—Dwellings	Type III—Concrete Block Type V—**Wood Frame Siding** Type V—Stucco Type V—Brick	7.35 **6.50** 6.90 9.30

* Territorial modifications vary from plus 14% in the Eastern Industrial Area to 0% for Southern California and minus 6% for the Southern States. Data was obtained from Marshall and Stephens, valuation engineers.

THE SAFETY FACTOR

Fire, Earthquake, Wind

Fire safety in school buildings is primarily a matter of exits.

Probably there is no safer place for school children to be in case of fire than in a one story classroom building having direct exits to the outdoors. As the number of stories increases, the hazard to life from fire increases, and no method of providing safety to occupants can be devised without creating a substantial drain on the taxpayer's dollar.

The inherent safety to occupants of the one story building applies to all materials of construction. Property damage and fire insurance, on the other hand, are directly related to materials of construction.

Fire insurance rates on educational buildings in California depend on a number of factors not necessarily pertinent to this discussion. Basic rates, however, in Table V give some indication of the relative hazard for various types of construction as evaluated by the Pacific Rating Bureau.

TABLE V—Fire Insurance Rates Typical West Coast Cities

Class A and B	Fire-resistive construction	30¢ per $100
Class C	Masonry construction	45¢ per $100
Class C	Masonry walls, wood floors & roofs	54¢ per $100
Class D	Wood frame	80¢ per $100

Offsetting the higher insurance rates in the case of the wood frame building is the fact that the first cost of the wood frame building is invariably less than that of a masonry or fire-resistive building. In addition, modern methods of fire prevention and fire protection serve to still further reduce the fire hazard and consequent cost of insurance.

All of the above items must be taken into consideration in determining how much of the tax dollar should be spent in providing fire safety. No "rule-of-thumb" formula can possibly be adequate for this purpose, but the information in Table VI below indicates that property losses as related to insurance premiums are not significantly different regardless of the materials of construction used in the building.

It might be argued that the above figures indicate that fire insurance rates are either too high on wood frame buildings, or too low on fire-resistive buildings, or even that all of the rates are too high. It must be borne in mind that Rating Bureaus which make fire insurance rates and fire insurance companies that sell fire insurance are dependent for financial stability on the ability of such rates to pay for fire losses experienced plus the cost of doing business.

It should also be noted that the above figures are for only one year and for a relatively small portion of the country. However, if it is agreed that the loss ratio figures are not significantly different for the various materials of construction, it follows that first cost of the building plus insurance rates properly amortized will provide a fairly accurate picture of how tax dollars may be conserved in this respect.

It can happen most anywhere. Damage to school building in California earthquake of 1933. Fortunately school was not in session and no one was injured. Photo by I.N.P.

TABLE VI—Ratio of Loss to Insurance Premiums for Educational Buildings in Protected Areas*, State of California—Year 1948.

Type of Construction	Loss Ratio
Frame	34.7%
Brick	43.6%
Fire-resistive	50.0%

* "Protected Areas" refers to locations where a regularly constituted fire department is available and certain other precautions are taken.

Here are a few questions and answers on earthquakes and tornadoes:

(1) Are we likely ever to have a destructive earthquake in our locality?

(2) Will the children be safe if they are at school and we have an earthquake?

(3) Would our school buildings really be safe in a tornado or even a very heavy wind?

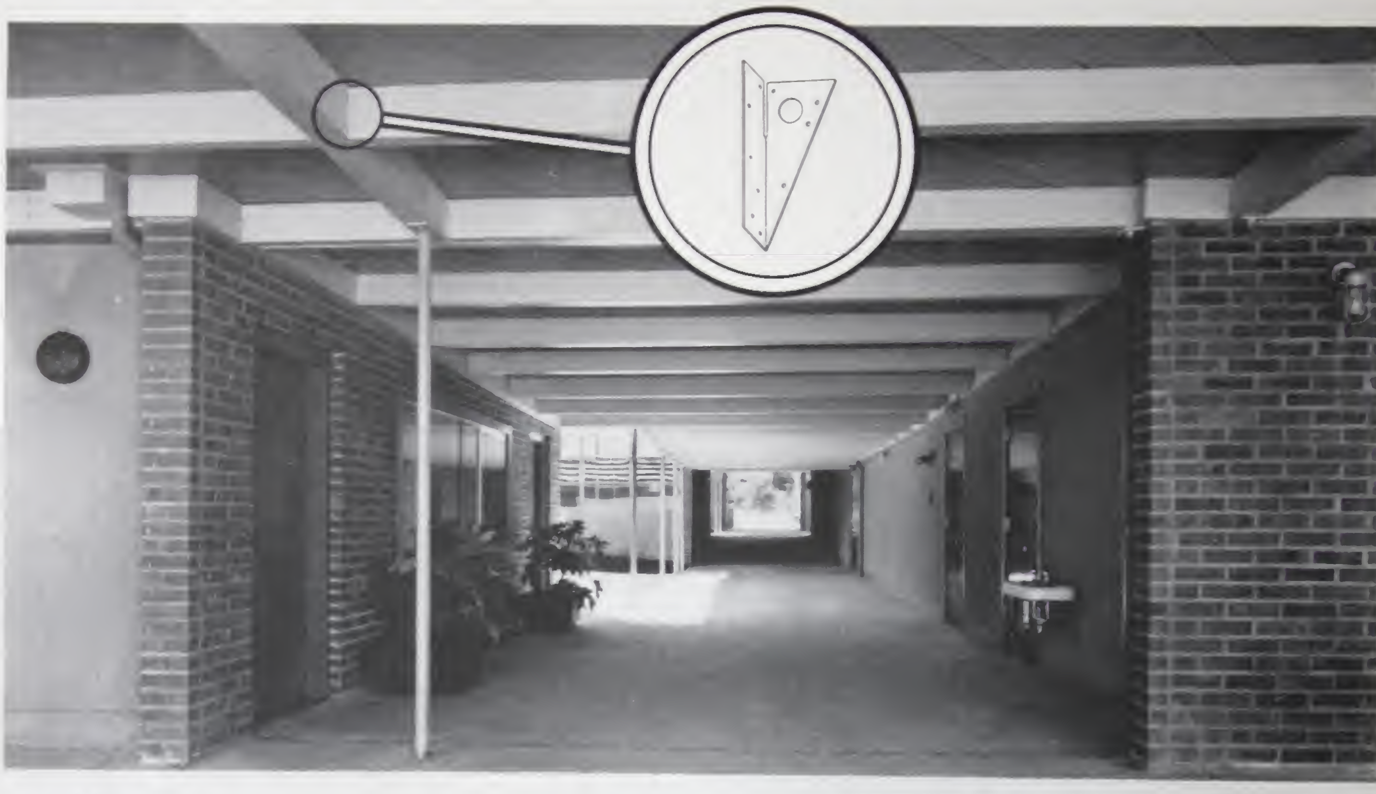
(4) Should we spend a little more of our tax dollar for earthquake and wind protection and perhaps economize in some other feature?

All of these and a good many other questions which concern the structural safety of buildings can be answered today with much more assurance than would have been possible 10 or 15 years ago.

As to whether you are likely to have an earthquake, the answer is "yes"—if your locality is in the United States and if "ever" is defined as within the next 100 years or more.

In general it may be expected that earthquakes are likely to occur most frequently along the Pacific Coast, less frequently on the Atlantic and Gulf Coasts and less frequently elsewhere. However, damaging earthquakes occurred at Quebec, Canada, in 1663, Boston in 1775, New Madrid, Missouri in 1811, Charleston, South Carolina in 1886, Gallatin County, Montana in 1925, and Seattle and Tacoma in 1948.

Fortunately the general consensus is that we have no good reason to expect earthquakes more severe than those of which we have records—and for such earthquakes it is



An increasingly popular method of obtaining both lateral and vertical support for beams which frame flush into girders. Teco Trip-L-Grip Framing Anchors were used at all such joints. Montecito Elementary School, Martinez, Calif. Cost per square foot $10.20. Bamberger & Reid, Architects. Photo by Roger Sturtevant.

possible to provide adequate safety to life in one and two story school buildings without excessive cost.

Experience in California, where earthquake protection has been built into all schools since 1933, has clearly indicated that "it can be done." Although it has not always been done in the most economical manner possible, it is a fact that no loss of life or serious injury due to earthquakes has occurred in school buildings in California since 1933.

It is true that no earthquake as damaging as the Long Beach earthquake of 1933 has occurred since, but there have been several of sufficient force to damage other buildings. Inspection of school buildings immediately afterward has given confidence to the public in California's present school building methods.

So, in answer to question (2) concerning safety, it may be confidently stated that children *can* be safe at school during a major earthquake *if* the school buildings are designed in accordance with known principles of earthquake protection.

Question (3) concerning tornadoes and windstorms cannot be answered so readily. Undoubtedly many existing school buildings would suffer severe damage and there would be serious injury or loss of life to the occupants if the building were in the direct path of a tornado.

Property damage and injury can occur in a heavy wind, which might be defined as one having a velocity of 75 or more miles per hour. The New England hurricane of 1938 caused property damage along the East Coast running to $40,000,000.

It is customary to design school buildings to resist a wind force of either 15 to 20 pounds per square foot of exposed surface, which corresponds to a wind velocity of about 75 miles per hour. Where this is done, and adequate attention is paid to all details of construction, such as connections between horizontal members and vertical members, etc., it is reasonable to expect that adequate safety against winds of this magnitude will be obtained.

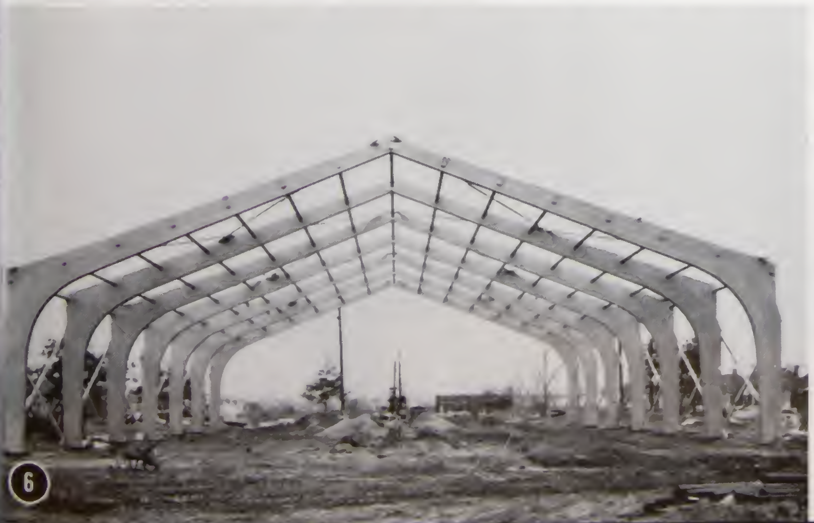
There are many well-developed methods of construction and devices for connecting the various parts of wood frame buildings, which can add both to wind and earthquake protection without imposing an undue burden on the taxpayer's dollar.

Some of these which may be briefly noted are: (a) diagonal sheathing of walls, floors and roofs, (b) proper connections between foundations and walls, between walls and floors, and between walls and roofs, (c) avoidance of any unbraced walls, such as underpinning between first floor and foundation.

Question (4) in the matter of spending for safety and economizing elsewhere has been answered in the affirmative in California and should be so answered elsewhere. This is particularly applicable to such areas as the Pacific Northwest, where two moderately severe earthquakes have occurred within the past two years.

It has been estimated that adequate earthquake protection for a wood frame building need not add more than 1 to 2 per cent to the cost. Such protection will ordinarily provide reasonable wind protection as well. Surely this expenditure is simply good insurance for our children.

1. Lamella wood roof construction produced by Summerbell Roof Structures, Los Angeles, Calif. High school swimming pool, Huntington Beach, Calif.
2. College of Puget Sound Field House, Tacoma, Wash. Clear span 168′ timber trusses using Teco connectors were fabricated by Weyerhaeuser Sales Co., Tacoma.
3. High School Auditorium, Duncan, Nebraska. Note attractive wood panelling. Timber arches manufactured by Rilco Laminated Products Inc., St. Paul, Minn.
4. Elementary school, Lincoln, Mass., uses Teco timber connector trusses. Anderson & Becksmith; Kilham, Hopkins, Greeley & Brodie, Associated Architects, Boston. Thomas Worcester Inc., Builders.
5. Unloading half arch sections of 81′ span, low "V" type, glued, laminated timber arches manufactured by Unit Structures Inc. Peshtigo, Wis., for St. Bartholomews Parochial School, Detroit, Mich.
6. Laminated timber arches in place for recreation building St. Bartholomews Parochial School, Detroit, Michigan. Walter J. Rozycki, Architect, Detroit.
7. Nerinx Hall gymnasium 75′ x 140′ Lamella wood roof prefabricated by Roof Structures Inc. Webster Groves, Mo. A. F. Stauder & Arthur Stauder, Architects, St. Louis.



The Clyde Lyon School in Glenview, Illinois, with good combination of materials is an outstanding example of modern one story school planning.

Residential in character, but modern in design and facilities, the new elementary school blends appropriately with the fine homes in the northwestern Chicago suburb. The central unit houses playroom, community lounge and cafeteria-visual aids rooms. Primary and kindergarten wings are to the right, intermediate wings to the left. Long porch protects children boarding school busses in inclement weather. Clerestory windows over corridors give classrooms bi-lateral illumination, a design feature that protects eyesight and fosters child progress. Perkins & Will, Architects-Engineers, Chicago, designed the building. Eric A. Borg Co. general contractor. Photo by Hedrich-Blessing Studio.

Wood trusses prefabricated by McKeown Bros. Company, Chicago, were used throughout the central wing and classroom wings. Generous use of wood throughout provides a warm and friendly atmosphere. Area 29,591 square feet. Cost per square foot $12.10.




EXHIBITION
"CREATIVE"


DECAY *and* TERMITES

Past practices in the construction of wood frame school buildings, erected 20 or more years ago, have without doubt resulted in the waste of unnecessarily large sums of taxpayers' money. It can be stated without qualification, however, that any waste today is inexcusable, and that with today's well developed methods of wood frame construction neither the hazards of decay nor termites need cause one penny's worth of damage in the modern wood frame building.

Well known and generally adopted methods of design and construction, which are today successfully overcoming both decay and termite hazards, include: (a) provision for adequate ventilation between ground surface and any timbers, (b) avoidance of contact between the ground and lumber. This is readily accomplished by using concrete or masonry foundation walls. Where lumber must be in contact with the ground, it should be pressure-treated with approved preservatives.

These simple precautions impose very little burden on the taxpayer's dollar.

→

"Unit" glued laminated 41′ wood beams, spaced 14′2″ O.C. to support roof on second floor over music room of Henry Mitchell School, Racine, Wis. Decorative offsets on beams were achieved by providing additional laminations, gluing them with the main beam in one operation thus forming an integral part of the beam. Beams designed and manufactured by Unit Structures, Inc., Peshtigo, Wis. J. Mandor Matson, Architect, Racine, Wis.

Lower left: All wood interior auditorium Ferguson, Mo. Wood trusses and purlins prefabricated by Roof Structures, Inc., Webster Groves, Mo.

Lower right: School gym, Wallowa, Washington. Segmental 90′ wood arches using Teco split rings, prefabricated by Weyerhaeuser Sales Company, Tacoma, Washington. Arches assembled and erected by contractor in less than one hour per arch.

FLEXIBILITY

The foregoing considerations are by no means all that must be weighed in planning for the housing of our school population.

A whole book could be, and many books have been, written to help the parent-teacher-school-board-taxpayer in his quest for the utmost value that may be obtained per dollar expended.

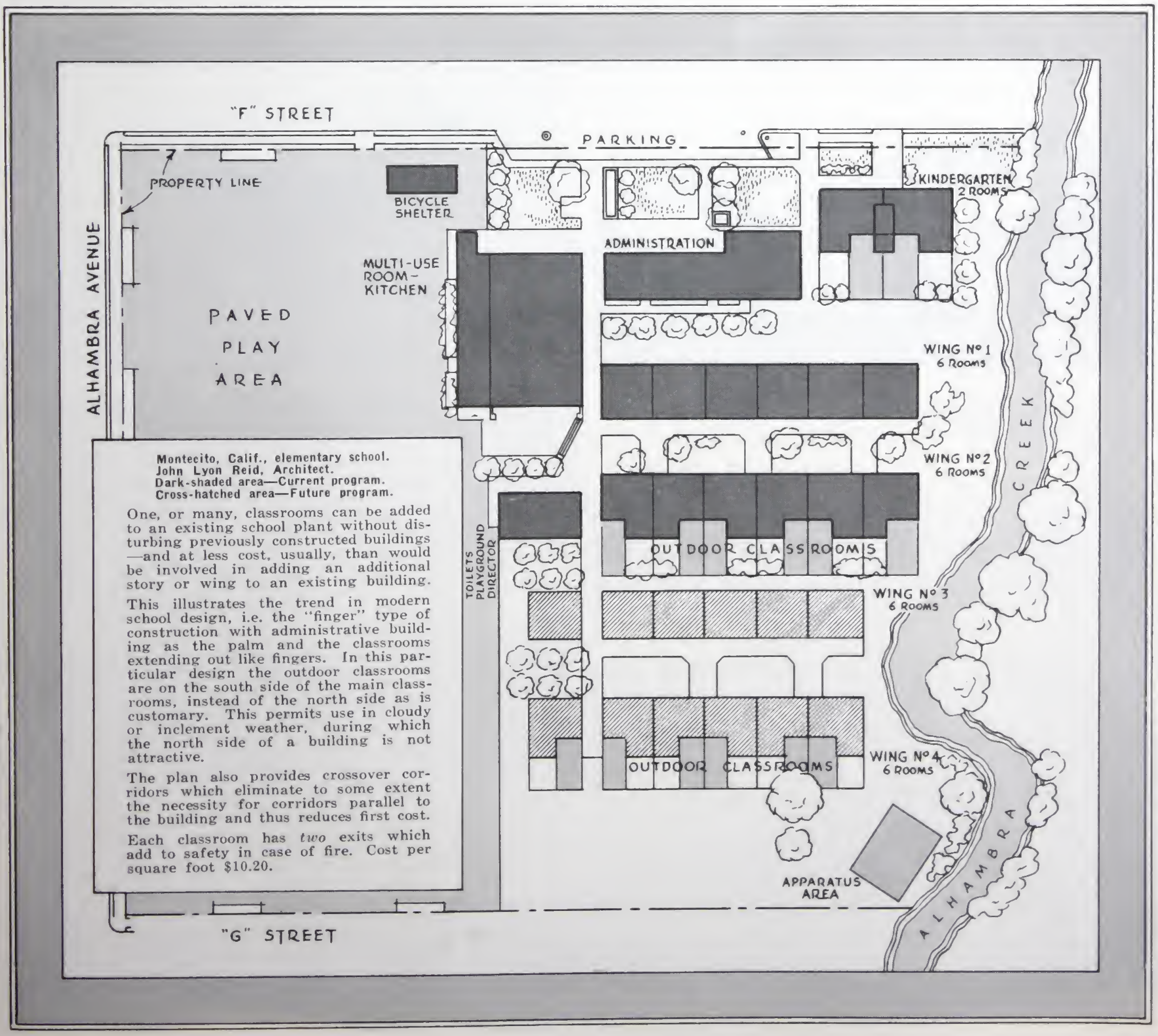
Since this publication deals primarily with the suitability of one story wood frame buildings for schools, it is pertinent to outline a few of the considerations which make them suitable and to illustrate some of the modern devices and methods of construction which have contributed to that end.

Nothing perhaps is more likely to happen in the life of a school plant than some change in teaching methods or requirements which will necessitate alterations in some of the buildings. It may be desirable to make one large classroom out of two small ones, as population trends change, or vice versa. Heating, plumbing, ventilation or lighting requirements are often subject to change.

Whatever the reason for altering an existing building, the *wood frame type of construction is flexible and lends itself readily and economically to minor or major changes.*

Most new school plants today are being designed for an anticipated increase in school population.

It is obvious that advance planning offers the maximum of flexibility and ease of providing the necessary facilities without rearrangement or interruption.



Montecito, Calif., elementary school.
John Lyon Reid, Architect.
Dark-shaded area—Current program.
Cross-hatched area—Future program.

One, or many, classrooms can be added to an existing school plant without disturbing previously constructed buildings—and at less cost, usually, than would be involved in adding an additional story or wing to an existing building.

This illustrates the trend in modern school design, i.e. the "finger" type of construction with administrative building as the palm and the classrooms extending out like fingers. In this particular design the outdoor classrooms are on the south side of the main classrooms, instead of the north side as is customary. This permits use in cloudy or inclement weather, during which the north side of a building is not attractive.

The plan also provides crossover corridors which eliminate to some extent the necessity for corridors parallel to the building and thus reduces first cost.

Each classroom has *two* exits which add to safety in case of fire. Cost per square foot $10.20.

PERMANENCE

How "permanent" should a school building be to realize the maximum of value from the taxpayer's dollar?

Permanence in school buildings is mostly a matter of obsolescence and population changes.

One dollar invested at 5% interest compounded annually will earn an additional dollar in less than 15 years. Conversely, every dollar unnecessarily spent on a school building today may be considered as imposing a burden of an extra dollar every 15 years. If, therefore, a school building could be constructed to last 15 years and then completely replaced with a new building costing the same amount of money, the total cost to the taxpayer would be no greater than if twice the amount had been spent on the original building.

Thus it would seem advisable to keep first cost as low as possible and rebuild at relatively frequent intervals.

This is not to imply that a life of 15 years should be considered as the most desirable. One view of this problem is expressed in the October 1949 issue of the *Architectural Forum:*

> "The small elementary school, of light construction intended for 25 or 30 years of use, would meet the changing pattern of community need much better than the heavy buildings whose physical life span of 50 years will probably far outlast their useful life. This is not only because school need is likely to recede, it is also because today's rapid developments in design and technology mean a more rapid rate of building obsolescence —a matter which has not yet been given adequate consideration by all types of building investors. If school need does recede, the small school building can easily find a continued useful life as a community center."

Above: Franklin School, Berkeley, Calif., erected of wood in 1901 successfully withstood San Francisco earthquake of 1906 and was still in use as a school in 1949.

Upper right: High School gym, Prairie City, Iowa. Glued laminated wood arches manufactured by Rilco Laminated Products, Inc., St. Paul, Minn.

Right: John Adams Junior High School gym, Santa Monica, Calif. Glued laminated wood arches manufactured by Summerbell Roof Structures, Inc., Los Angeles. Joe M. Estep, Architect. Hillman & Nowell, Engineers. James I. Barnes Construction Company, Contractor.

Below: Slauson School, Azusa, Calif. Kistner, Curtis and Wright, Architects.

MODERN TIMBER CONSTRUCTION

Modern methods of timber construction have taken long steps since the days of the little, one room, township school.

In the past twenty-five years the recognition of timber as an engineering material has given school engineers and architects a new tool in this easily worked, versatile material.

Departing from the old-time conventional idea of "size for strength" there has emerged from the lumber testing laboratories a new material—timber. The building profession now knows that, pound for pound, timber does just as much work as other materials and in its proper fields of use performs an equally satisfactory service, and generally at lower cost.

Three systems of timber construction have developed to the benefit of those responsible for schools and other frame structures.

The TECO connector system of construction now in its seventeenth year of use has found wide acceptance in schools. For one story schools now in vogue its use will be more widespread. Timber connectors strengthen joints so that it is possible to utilize 80% to 100% of the strength of the members instead of 40% to 60% as formerly.

Of more recent vintage but with a widespread appreciation for appearance and performance is glued-laminated construction, or the making of "big ones out of little ones." Through glued-laminated timber it is possible to overcome problems, which might otherwise be troublesome, due to improper seasoning. Thus the architect may plan for beautiful exposed timber members that will not warp, check or split.

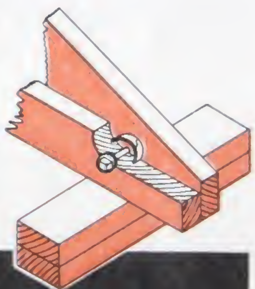
Lamella construction in this country preceded the two aforementioned types. In the form of two-hinged arches this attractive diamond shaped construction is architecturally attractive. Lamella roofs need no ceiling coverage because of the decorative effect of the lamellas themselves.

All three systems of construction are furnished by experienced timber fabricators located in all sections of the country and all may be used with confidence for all types of school buildings.

Left: Winter Sports Building (200′ x 400′) University of Minnesota. Prefabricated timber trusses, using Teco connectors, manufactured by Timber Structures, Inc., Portland, Oregon. C. H. Johnston, Architect.

Lower left: Blythe Park School gym, Riverside, Illinois. Glued laminated wood arches manufactured by McKeown Bros. Company, Chicago. Perkins & Wills, Architects-Engineers. Photo by Hedrich-Blessing Studio.

Lower right: Loyola University Gym, Los Angeles. Lamella roof (94′ x 132′) manufactured and erected by Summerbell Roof Structures, Inc., Los Angeles. Wallace Neff, Architect. McNeil Construction Company, Contractor.



Cut-away joint illustrating use of Teco split ring in heel construction. By spreading the load over a large area, split ring connectors provide the most economical connections for structural timber joints. 2½″ split ring in trussed rafter joint illustrated.

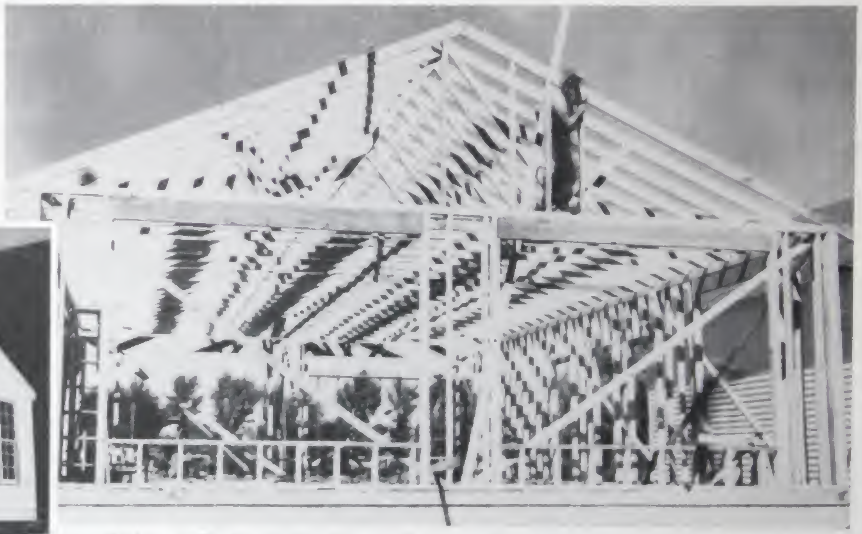
TECO TRUSS DESIGNS

Typical truss designs for one story schools employing the TECO connector system of construction are illustrated on the opposite page.

These typical designs are prepared in accordance with the "National Design Specification for Stress-Grade Lumber and Its Fastenings" as recommended by the National Lumber Manufacturers Association. Copy of the specification and copies of the typical designs will be supplied complimentary upon request to the Timber Engineering Company.

TECO trussed rafters are recommended for short span construction. Common 2 x 4's and 2 x 6's are used. Requiring no load-bearing partitions, these rafters place a project under cover more rapidly than traditional methods of construction. The clear work space thus secured effects large time, labor and material savings by permitting greater flexibility of operation for the mechanical trades.

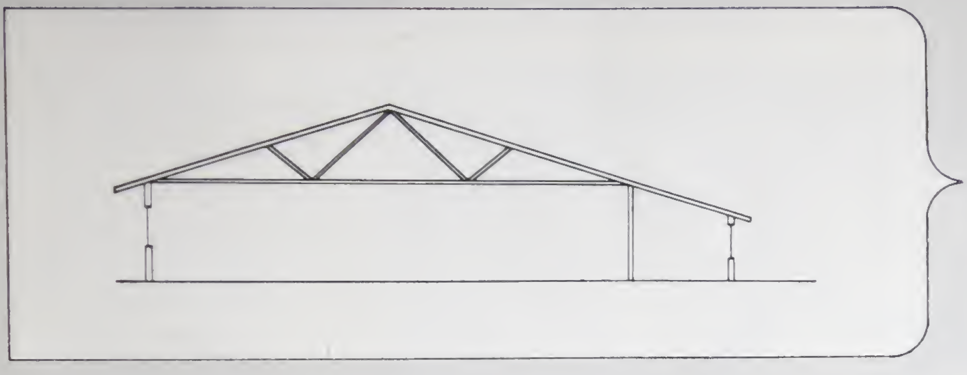
Below and Right: Temporary Classrooms, Benjamin Franklin School, Villa Park, Illinois.



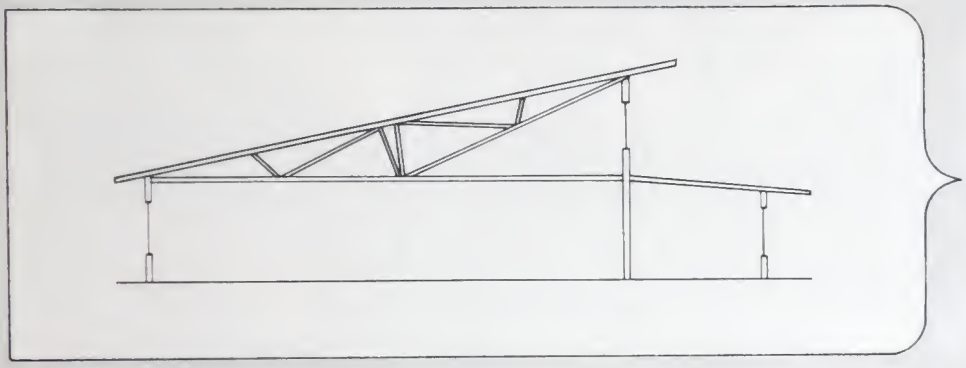
Below: Typical Fink wood trusses using Teco connectors for dormitory at William Smith College, Geneva, N. Y. Trusses fabricated by Cartwright and Morrison, Holcomb, N. Y.

Above: Demountable wood frame, two classroom school, capacity 80 students, is Chicago's solution to the problem. Twenty-one of these schools were built through 1949 with the last one complete with yard improvements costing only $262.00 per pupil. John C. Christensen, Architect.

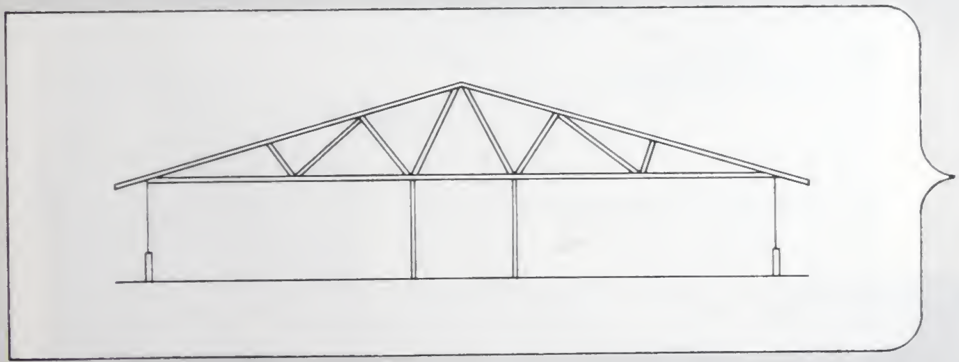
Right: New York State Normal School dormitory (57' x 148') under construction using Teco trussed rafters prefabricated by Cartwright and Morrison, Holcomb, N. Y. Dormitories at eight different locations have this type of economical wood construction.



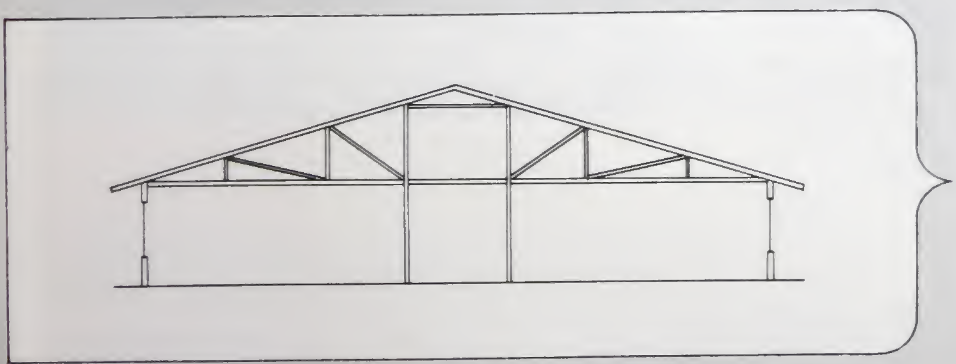
(a) Clear-span classrooms up to 50′ with side corridor. Trussed rafters 2′ spacing. Typical designs #585 (dry wall ceiling) and #590 (plaster ceiling) for spans 20′ to 32′ and roof slopes 4, 5, 6, and 7 in 12. #597 for spans 34′ to 50′.



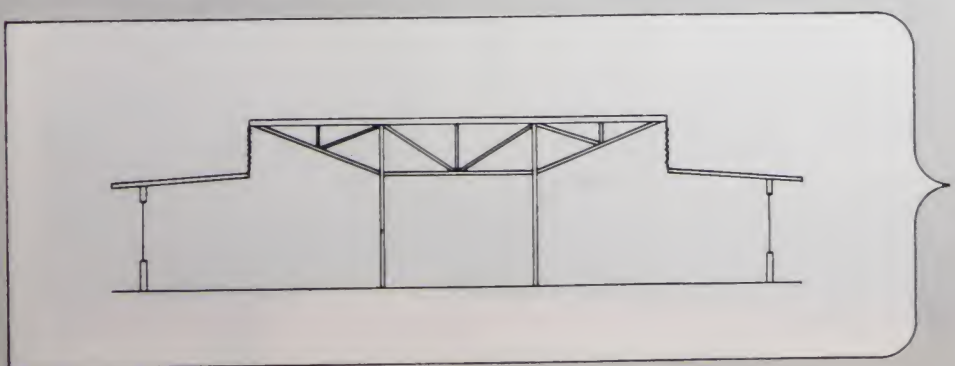
(b) Well lighted classroom and side corridor. Typical design #608, sawtooth trussed rafter, 2′ spacing, slope 4 in 12, spans 20′ to 32′. Typical design #605, sawtooth truss, 8′ spacing, span 30′. Clerestory windows provide lighting to inside walls. Also adaptable with class rooms on both sides of corridor.



(c) Glass walls permitted by non-bearing exterior walls with cantilevered trussed rafters bearing on central partitions. Ceiling may be sloped for better lighting if desired. Typical design #609, 2′ spacing, building width 30′ to 50′.



(d) Classrooms 20′ to 30′ with integral corridor framing with two sawtooth trussed rafters. Slope ceiling for better inside wall lighting and for a flatter roof. Typical design #610, 2′ spacing.



(e) Cantilever trusses for integral classroom and corridor framing and ideal clerestory lighting. Ceiling on bottom chord of truss or boxed or exposed trusses. Typical design #611, 10′, 12′, or 15′ spacing, 28′ class room.

Left: School Gym, McMinnville, Oregon. Tom Burns, Architect. Glued laminated wood beams manufactured by Timber Structures, Inc., Portland, Oregon.

Right: Elementary school room, Edmonds, Wash. Glued laminated wood beams and Arch-Teco bowstring trusses manufactured by Timber Structures, Inc., Portland, Oregon. John H. Sellen Construction Co., Contractor.

Above: School Gym, Bonner, Mont. Glued laminated V-type wood arches manufactured by Timber Structures, Inc., Portland, Oregon. William J. Fox, Jr., Architect. Pew Construction Co., Contractor, Missoula, Mont.

Right: Franklin D. Roosevelt High School, Compton, Calif.

TRIP-L-GRIP FRAMING ANCHORS

Just as TECO connectors serve to strengthen primary timber joints, so do Trip-L-Grip Framing Anchors make stronger secondary connections in wood framing.

Trip-L-Grip provide the ideal connection for anchoring rafters to trusses or purlins, girts to columns, floor joists to beams, ceiling joists to beams or trusses, beams to posts and ceiling joists to small headers.

Wind anchorage is always a factor. With these anchors rafters are tied tight—a strong guard against uplifting of roofs in high winds. For earthquake areas Trip-L-Grip are also useful in knitting the entire structure into a better shock absorbing unit.

Architects' specification sheets here illustrated are available free upon request to the Timber Engineering Company.

aia file 19-B-5

architects aids for BETTER BUILDING

TIMBER ENGINEERING COMPANY

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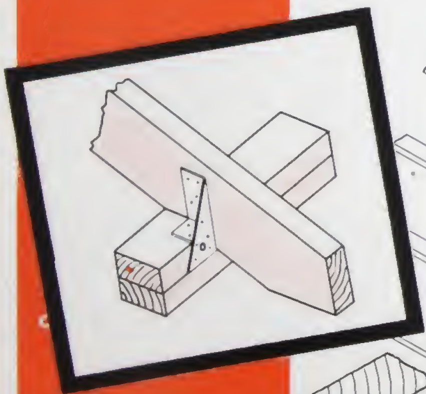
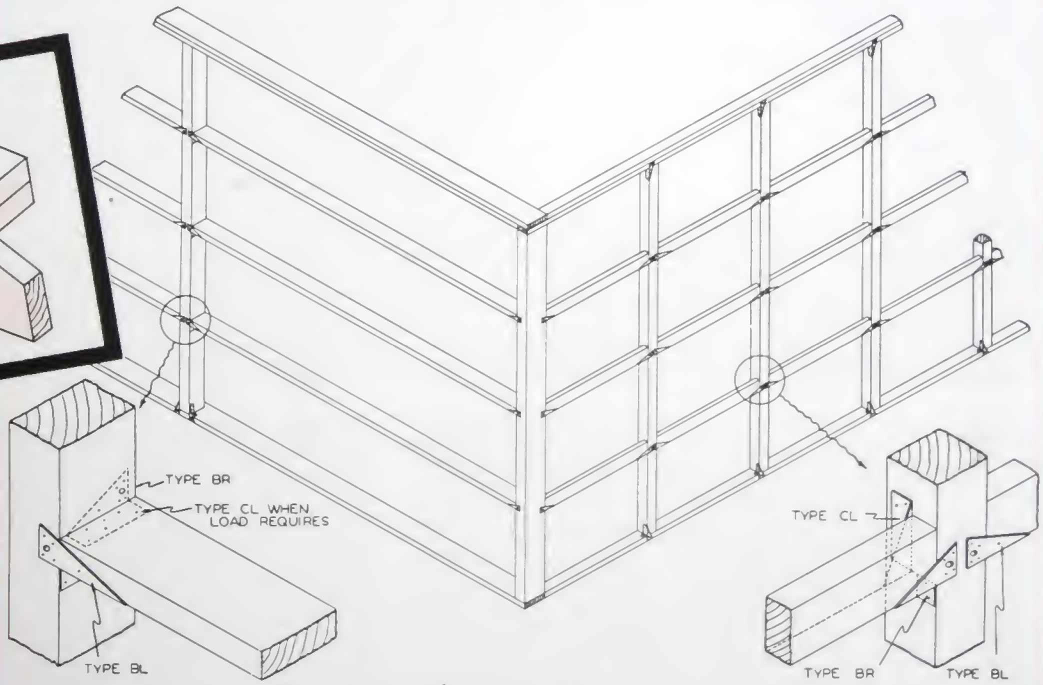
TECO Trip-L-Grip FRAMING ANCHORS **SPECIFICATION SHEET NO. 5**

Type AL Trip-L-Grip framing anchor used to anchor rafters or trussed rafters to walls.





Trip-L-Grip specification sheet #5 illustrating Post and Girt construction often used in school construction. One of a series, each sheet covering one type of Trip-L-Grip use for quick, easy reference by architects, designers and builders.

SPECIFICATIONS

GIRT TO POST

When Girt is same depth as post, fasten Girt to Post with two type B Trip-L-Grip (one BR, one BL) at each end. For heavier loads a type C Trip-L-Grip may be added, or substituted for one Type B.

When Girt is less in depth than Post, fasten Girt to Post with one type B and one Type C Trip-L-Grip at each end (BR and CL at one end, BL and CR at other end).

Note - For special details, write Timber Engineering Company.

aia file 19-B-5

TECO CONSULTING SERVICES

The Timber Engineering Company, affiliated with the National Lumber Manufacturers Association, is a lumber industry service organization located in Washington, D. C. It is devoted to the development of new uses, and more economical utilization of wood, forest products and their derivatives.

As the lumber industry's central clearing house for design information, we have today over 250 typical designs, which are supplied complimentary to builders, architects, and engineers as illustrations of how to use TECO connector construction. These designs can be used as guides in designing to fit specific needs.

Timber fabricators, located in all sections of the country, not only render similar services but they also furnish prefabricated timber framing laid down at the job site ready to erect, and they can also do the erection.

Distributors of TECO products are located in principal cities. In many cases the distributors have engineering consultants on their staffs.

School planners, architects, and builders are invited to make use of these services. Additional copies of this bulletin for distribution to Parent-Teachers Associations, other organizations and individuals are available upon request, free of charge.

Left: High school gym under construction, Palm Springs, Calif. Glued laminated 106′ wood arches manufactured by Summerbell Roof Structures, Los Angeles. Harry J. Williams, Architect. W. D. Haxton, Contractor.

Lower left: Library, Immaculate Heart College, Los Angeles. Timber trusses manufactured by Summerbell Roof Structures, Inc., Los Angeles. Albert C. Martin & Associates, Architect & Engineer. J. A. McNeil, Contractor.

Lower Right: Sweet Grass County High School gym, Big Timber, Mont., under construction. Monocord 78′ wood trusses manufactured by Weyerhaeuser Sales Co., Tacoma, Wash.

Above: Cafeteria room Montecito School, Martinez, Calif. John Lyon Reid, Architect. Photo by Roger Sturtevant.

Left: High School cafeteria Bell Gardens, Calif. Lamella roof manufactured and erected by Summerbell Roof Structures, Inc., Los Angeles. Marsh, Smith & Powell, Architects. Hillman & Nowell, Engineers. Baruch Corporation, Contractor.

Lower left: Slauson School, Azusa, Calif. Kistner, Curtis and Wright, Architects.

Lower right: High school gym Henderson, Iowa, under construction. Glued laminated 80′ wood arches manufactured by Rilco Laminated Products, Inc., St. Paul, Minn.

LUMBER LITERATURE

NATIONAL LUMBER MANUFACTURERS ASSN.

1. Wood Structural Design Data is a 300-page book published by the National Lumber Manufacturers Association. It contains complete tables of safe loads for wood joists, beams and columns covering the full range of commercial sizes, species and grades, and of the spans and heights ordinarily used. The book contains in addition much information on the grading of structural timber, properties of sections, board feet per linear foot and other data useful to designers. Price $2.00 per copy: with following supplements $2.25, U. S. Postage paid.

Wood Structural Design Data Supplements

Supplement 3. Maximum Spans for Joists and Rafters.

Supplement 5. Wood Trusses—stress coefficients, length coefficients and angles.

Supplement 6. Stud Walls—safe axial loads.

2. National Design Specification for Stress Grade Lumber and Its Fastenings. 1944, revised 1948. The industry specification recommended by the National Lumber Manufacturers Association. A 64-page technical bulletin. Free.

3. Heavy Timber Construction Details. 16 pages. Detailed Drawings and specifications for heavy timber construction, as recommended by the National Board of Fire Underwriters. Free.

4. Lumber Literature. 56 pages. This booklet lists printed information available through the Federated Associations of lumber manufacturers which compose the National Lumber Manufacturers Association.

Practically all commercially important American species of wood are available through the member mills of the Federated Associations. Therefore, this listing includes most of the literature available on lumber and its use. Free.

5. Exposing the Termite. Booklet giving brief history of the termite, how to detect its presence, and good construction methods of preventing termite attack. Free.

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TIMBER ENGINEERING COMPANY

1. Teco Design Manual. A 28-page bulletin giving technical data on Teco connectors. This Manual contains complete information for the use of engineers in designing wood structures. Free.

2. Typical Lumber Designs. A bulletin listing over 400 typical designs for various types of light and heavy frame structures. Designs include quantities and material lists. Free.

3. Installing Teco Timber Connectors in Light and Heavy Structures. Pictorial booklet showing fundamental procedure for installing connectors in timber joints. Free.

4. Trip-L-Grip Framing Anchors. Six-page booklet illustrating the use of anchors in secondary connections in wood framing. Free.

5. Modern Home Planning. An 8-page booklet showing the economy of Teco trussed rafters for homes, garden apartments, and short span commercial and industrial buildings. Free.

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